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BIOLOGY TZ1 (IB Latin America & IB North America)

Overall grade boundaries

Higher level

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 16	17 - 32	33 - 43	44 - 55	56 - 67	68 - 80	81 - 100

Standard level

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 18	19 - 34	35 - 48	49 - 59	60 - 69	70 - 80	81 - 100

Time zone variants of examination papers

To protect the integrity of the examinations, increasing use is being made of time zone variants of examination papers. By using variants of the same examination paper candidates in one part of the world will not always be taking the same examination paper as candidates in other parts of the world. A rigorous process is applied to ensure that the papers are comparable in terms of difficulty and syllabus coverage, and measures are taken to guarantee that the same grading standards are applied to candidates' scripts for the different versions of the examination papers. For the May 2008 examination session the IB has produced time zone variants of the Biology papers.

Internal assessment

Component grade boundaries

Higher level

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 9	10 - 15	16 - 21	22 - 27	28 - 31	32 - 37	38 - 48

Standard level

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 9	10 - 15	16 - 21	22 - 27	28 - 31	32 - 37	38 - 48

Clerical procedure

The moderators generally agreed that the procedure for the selection of the moderation sample was understood and correctly followed by most schools. It is most important, however, that the teachers keep up to date with these. There are a significant number of examples of schools using old 4PSOW forms and the requirement that the candidates sign the 4PSOW form was missed by a large number of schools. For candidates examined from May 2009 there will be important changes in the procedures used by the IB for internal assessment. The teachers MUST be aware of these changes.

Teachers who included the "complete", "partial" and "not at all" breakdown of their marks were providing helpful information to the moderators. This combined with comments and feedback to the candidates made it very clear as to how the teachers were awarding marks.

There are a large number of teachers that take a lot of time and trouble to prepare their Internal Assessment sample. This effort is very much appreciated.

A problem, which directly affects the progression of the moderation, is when teachers do not enclose all the instruction sheets and/or summaries of oral instructions for the investigations in the moderation sample. Most schools complied with this requirement for the investigations involving Planning (a) and (b) assessment. It is also necessary, however, for investigations where Data Collection is being assessed. When Data Processing and Presentation is being assessed the method (designed by the candidate or provided by the teacher) and the raw data are required. Finally when Conclusion and Evaluation is being assessed all the steps in the scientific process are needed. This will still be true for the revised procedures from May 2009.

The duration of the practical programmes was generally correct and evidence of the Group 4 Project was usually present though a number of moderators commented on the absence of evidence for the Group 4 Project.

A problem which persisted this session concerns collusion between candidates. Too often moderators noted that material is submitted which clearly a copy of another candidates work. This type of incident is the subject of a Problem Report Form. This will lead to an enquiry into malpractice by the IB examination board.

Areas of strength

Most teachers covered adequate material with very varied practical programmes. Many moderators noted an improvement in the types of investigations used for planning investigations. There is evidence of a decrease in the number of investigations that collect purely qualitative data. This is a move in the right direction because in May 2009 all assessed investigations will require the collection and processing of quantitative data.

Areas of weakness

A problem raised by many moderators was the trivial nature of some investigations submitted for moderation. Where schools were presenting work of a sufficient complexity this tended to be the case with all of their assessed work.

Moderators noted that some teachers still give too much help for the assessed work. In Planning (a), aims and objectives are being given which are too detailed. For Planning (b), methods were given and were followed with no modification by the candidates. In Data Collection less photocopied data sheets was being used but in Data Processing and Presentation candidates were still being told how to process their data in some schools.

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It must be stressed that when an investigation is used for internal assessment it is the work of the individual candidate which is to be assessed not that of a group. Teachers must provide opportunities within the practical programme where candidates may be individually assessed. The problem of overt collusion is treated above but teachers must set assignments that have enough scope to them to ensure that all the candidates are not going to be doing effectively the same investigation. The general aim set by the teacher needs to be sufficiently open-ended and the material and protocols available should be sufficiently diverse.

There was generally a lack of awareness by candidates of the degrees of precision in their measurements. This was perhaps the commonest comment from the moderators. In the revised programme it will be expected that candidates should develop an awareness of the limitations of their instruments and their methods.

They should be using methods of error analysis (e.g. standard deviation and correlation) in their processed data. Of course this requires that the investigations are sufficiently complex and collect sufficient data for candidates to carry out this analysis.

The consistency in the number of decimal places used also presented problems. Some candidates were not consistent with them at all especially in their processed data. If data is measured to one decimal place then the mean calculated from this data cannot be accurate to three decimal places. A lot of these errors are due to a weakness in the appreciation of processing done on calculators.

Grade inflation seems to be a problem in certain schools. It is sometimes observed that candidates have clearly not responded to an aspect of a criterion (e.g. there is no sign of the variables having been identified PI (a) Aspect 3). The teacher comments on this omission and still awards the candidate full marks. It is possible that this may be due to the teacher scaling the marks. The Internal Assessment criteria are for application throughout the IB schools and thus they cannot be treated like this. The criteria must be applied rigorously or the effect of the moderation will be severe down grading.

Rules applied by the moderator

At the start of the moderation session the moderators in the team are provided with guidelines which are intended to bring everyone into line and establish some ground rules for moderating. Following the moderation samples of the moderators work are sent to a senior moderator for remarking. A summary of the ground rules are given below:

- Do not try to compensate for lowering a candidate's mark by raising another candidate's within the sample. These changes will not necessarily cancel out.

- Your own marking is subject to adjustment by the senior moderator/principal moderator so you cannot comment on the standard of marking on the 4/IAF feedback form to the school.

- Always apply the principle of positive marking. If it is a borderline judgment support the teacher's award and annotate your marking with 'borderline-teacher supported' so that your senior moderator follows your reasoning.

- Do not worry if you find yourself consistently supporting the teacher. If that is what the work deserves then there is no problem.

- Senior moderators should continue to support the teacher where possible even if it means disagreeing with the assistant moderator.

- If you have a query as to the marking standard, contact your senior moderator immediately. It is possible to mark other samples while awaiting clarification, but you may have to re-mark all pieces of work in which the same situation occurred once your clarification is received.

- Senior moderators should endeavour to reply to queries as soon as possible.

- Do not change your marking standard once your sample has been sent to the senior moderator/principal moderator as this will not be reflected in the moderation factor. Remember to keep annotating the candidates' work in case an IMR report is called for by the school after the diploma grades are published.

- Choose a sample of eight candidates that cover a wide mark range so that there are no marks in a zone in isolation. Since there are many concerns that it is the high achievers who are most prone to be marked down, a couple of marks above 26 out of 30 should be included where possible.

- Choose a sample that includes a wide range of schools.

- Do not include candidate work that you are unsure about in the sample to be sent to the senior moderator.

- If you have schools in your allocation which have serious problems with IA avoid including those in your sample. They are atypical. If you are concerned about them fill in a PFR form.

- Do not punish simplicity through downgrading; comment appropriately on the form 4/IAF.

- Trivial investigations will probably be affected by moderation more seriously than complex investigations because they lack scope in discriminating between the candidates. A clear message needs to be sent to these teachers in their feedback.

- Bear in mind that there should be no difference in the application of the criteria to higher level or standard level candidates.

Be sure to read:

- the Examiner's Manual

- any further guidance from your senior moderator very importantly the Teacher Support Material (TSM) 1 and 2 on the Online Curriculum Centre (OCC)

There are a number of specific situations that occur regularly. There are a number of specific responses to these. One is where too much help or guidance has been given by the teacher the other is in the presentation of uncertainties to the data.

Where too much help has been given

Inevitably in your allocation you will come across write-ups where a teacher has quite clearly given too much assistance to the candidates. Some common examples:

- Planning (a): the research question, hypothesis and/or variables are given. A general aim is fine if the candidates have significantly modified it (e.g. made it more precise).

- Planning (b): a method sheet is given which the candidate follows without any modification. All candidates are using identical methods. **Note:** A basic or standard protocol may be given by the teacher (e.g. the rate of photosynthesis may be determined by counting the bubbles released by a pond weed) but this must provide

enough scope for the candidates to modify it (e.g. establish the independent variable, controlling variables, providing periods of equilibration, ensuring fair testing between the experiments etc).

- Data Collection: a photocopied table is filled in by the candidate. **Note**: Data logging by a computer or calculator interface is acceptable. If, however, you have doubts about the degree of automation, contact IBCA to ask the school for details of their data-logging system.

- Data Processing and Presentation: a graph with axes already labelled is provided.

- Conclusion and Evaluation: structured questions are given to heavily prompt the candidate through the discussion, conclusion and criticism.

In such cases, do not assume that the mark awarded by the teacher should be reduced to zero. **Examples:**

Criterion	Problem	Teacher awards	Maximum moderator can award
Planning (a)	*Teacher gives the problem or research question*	*c; c; c = 3*	*n; c; c = 2*
Planning (b)	*It is clear that the candidates have been told what apparatus and materials they require.*	*c; c; c = 3*	*n; c; c = 2*
Data Collection	*The candidates have used a photocopied data table with headings and units.*	*c; c = 3*	*p; n = 0*
Data Processing and Presentation	*The candidates have been told, on the method sheet, to draw a graph from their raw data and which variables to plot.*	*c; c = 3*	*c; n = 1*
Conclusion and Evaluation	*The candidate has only indicated as a criticism that they ran out of time and their only suggestion as an improvement is that they should repeat the investigation.*	*c; c; c = 3*	*c; n; p = 1*

For further guidance contact your team leader.

In all cases, constructive feedback to the teacher is needed. Always be positive, be diplomatic, give them the benefit of the doubt and give clear, useful advice.

When you are moderating the investigations, remember that we do not know the candidate's prior knowledge or skills. Thus we cannot anticipate the interpretation of the data using a particular piece of theoretical background nor can we anticipate a particular way of analysing the data. We should award marks more for what the candidate has achieved rather than what he/she has omitted.

Errors and uncertainties

It is now expected that the candidates treat uncertainties in their data. This has an impact on Data Collection (DC) Aspect 1 and Data Processing and Presentation (DPP) Aspect 2.

Note: Data processing may well take place in the same table used for the raw data. This is acceptable, there is no expectation for separate tables for raw and processed data.

Degrees of precision (DC)

Where instruments are used the degree of precision should be given (e.g. $\pm$ 0.1 cm) where it has an impact on the investigation. This will be particularly true for biochemistry investigations (e.g. enzymology) where laboratory grade reagents are being used (e.g. volumes, temperatures). However, where the biological material used is derived from a natural source, (tissue or whole organisms), the natural variation of the material may mean, that degrees of precision can be treated as insignificant.

Significant figures (DC and DPP)

The number of decimal places should not exceed the precision of the instrument used if it is given.

The number of decimal places should be constant for the data in a column of figures.

For data derived from raw data (e.g. means) the number of decimal places should not exceed those of the raw data.

In the calculation of mean population density, results to the nearest whole organism are expected.

Deriving uncertainties through processing (DPP)

We are not expecting the propagation of errors in processed data.

Standard deviations are expected only where the data permits (i.e. a sample size of at least 5 and a normal distribution).

Candidates may go even further and determine confidence limits through the standard error of the mean. This is acceptable but not obligatory.

A candidate may also indicate the range of uncertainties as the range between the highest and the lowest value in a sample. This is acceptable but not obligatory.

Candidates may also indicate uncertainties by tracing a trend line through their data on a graph.

Candidate performance against each criterion

Planning (a)

As stated some teachers provided too much guidance e.g. "Plan an experiment to investigate the effect of temperature on the rate photosynthesis of a green plant". The independent variable has been given by the teacher in this statement.

The aim or research question should contain the name of the organism that was used (ideally the scientific name) or the name of the source material e.g. catalase from the tuber tissue of potato (*Solanum*).

Formulating a hypothesis is also still in need of attention. The candidates are frequently not explaining their hypothesis scientifically, yet some teachers still award "complete".

Candidates are also failing to identify the independent variables or the controlled variables of their experiment. A number of teachers are awarding "complete" when the candidates have not fulfilled this aspect and some teachers still seem to be unaware of what independent and dependent variables are. Variables need discussing in order to identify those that can be controlled and those that may influence the investigation but cannot be controlled.

This is probably the weakest aspect of this criterion both in its treatment by the candidate and in the marking done by the teachers. Either it is missed out or the candidate lists a series of variables without much discrimination.

Investigations where candidates are working in groups, such as the Group 4 Project, are to be avoided for the assessment of the two planning criteria, unless the individual contribution of each candidate can be clearly identified. The evidence seems to suggest that this practice is diminishing. In the revised programme the Group 4 Project will <u>only</u> be used for the assessment of the Personal Skills criterion.

Planning (b)

Most teachers were providing adequate scope for the candidates to plan their own investigations. However, many moderators noted that sometimes the investigations are trivial. There were also reports of investigations that were too similar from one candidate to the next. Teachers in these cases may need to consider setting the planning exercise under test conditions.

In listing materials, candidates often missed some essential items. For instance, it is impossible to investigate a rate without some form of timer. Solutions were often listed or mentioned in the method without giving any idea of their concentrations or volumes, this would be particularly important to control during enzyme activity investigations.

In the control of variables it was rare to find candidates giving their materials time to equilibrate to the environmental conditions, especially where the investigation was using whole organisms (e.g. in transpiration or in photosynthesis).

Candidates appear to be considering replicates of their experiments resulting in sufficient data being collected. In the revised programme it will be expected that the candidates plan to collected significant amounts of data over the range of the independent variable and at sufficient intervals to observe a trend.

Data Collection

Raw data must be presented. Candidates in some schools are still presenting averages or rates as raw data.

Some teachers are still selecting investigations that generate data that is too trivial. Their candidates are not being tested effectively on their capacity to measure and to organize the data. The data should be sufficiently complex so that it can discriminate between candidates. Producing significant amounts of complex data does not necessarily require sophisticated apparatus or costly reagents. It can be understood that some investigations are time consuming and do not generate a lot of data in a lesson. Though they have their place in a scheme of work it would be advisable to avoid using these for internal assessment.

Data tables must be accompanied by clear precise titles (e.g. "The data" is insufficient).

The most common problem raised by the moderators, concerned uncertainties. Candidates should be indicating the degrees of precision in their measurements based upon the instruments that they are using. They should also be consistent in their application of decimal places. From the comments made by some teachers on their candidates' work, they are aware of the need for uncertainties to be given in raw data yet the fact that the candidate has failed to state them does not have an impact on the marks awarded by the teacher.

It is clear that "complete" does not mean perfect but there are occasions where the quoting of uncertainties will be very important when evaluating the reliability of the data. E.g. when using

the changes in mass or size to determine the water potential of plant tissues the degree of precision of the balance or the ruler used is important.

Qualitative data alone will no longer be adequate for assessment of Data Collection and Processing in the new programme. However, qualitative observations that accompany the quantitative data will be expected.

Data Processing and Presentation

When quantitative data is produced by an investigation, some teachers still make the mistake of telling the candidates how to process it. Many teachers seem to think that they can teach the mark and recapture method of population estimation and then assess it for DPP at the same time. This type of investigation is inappropriate even if the candidates have not been told what form of processing to use because there is not much scope for the candidates. Either they use the Peterson (aka Lincoln) Index or they do not.

There are some signs of candidates carrying out error analysis in their processed data but not enough. Use of trend lines or error bars showing uncertainties will be expected in the new programme.

Several candidates are using spreadsheets to process their data and to create graphs, which is good. This will become an essential part of the course in the revised programme. Unfortunately they show signs that they have not yet mastered the basics of graph drawing. For example, trying to plot a curve using three data points is inappropriate. Drawing graphs of raw data may be the first step in analysing the data but it is not likely to score complete. Some candidates think that plotting the data from each of the replicates rather than their means is adequate. When graphs are drawn manually some candidates seem to have difficulty in using a ruler and an excessive number do not use millimetre graph paper.

Conclusion and Evaluation

Candidates still show little evidence of having consulted literature sources with which to compare their results. Background research to support a conclusion will be essential where it is considered relevant in the revised programme. Correct citation of the source on information will be expected.

Teachers are still ignoring the need for the candidate to criticize and suggest improvements to the investigation. It is one of the areas where the teachers are ignoring the criteria. Moderators are obliged to lower the marks in cases like this. If a candidate fails to evaluate the investigation and suggest improvements, the maximum the candidate can score is

"cnn" = 1

When weaknesses are highlighted and improvements suggested they should not be superficial. The evaluation should be based upon the errors and uncertainties revealed by their data. E.g. If an outlier appears in a series of data one would expect the candidate to spend some time exploring the origins of this error. Too often one gets the impression that the candidate feels that they have to say something to fulfil this aspect so their evaluation becomes trivial or irrelevant. The candidates often fall back on suggesting poor manipulative skills can cause unexpected data, leaving the teacher to evaluate only the conclusions drawn. Statements like "I could have used the balance incorrectly" are not very helpful.

Manipulative skills

The practical programmes, in general, provide adequate scope for assessment of this criterion. In the revised programme this will be assessed summatively over the whole course.

Therefore, there will only be one mark for this criterion. Consequently moderators will expect to see signs that the candidates have been involved in a number of tasks of suitable complexity.

Personal Skills

This criterion will <u>only</u> be assessed during the Group 4 Project in the revised programme. So there will only be one mark for this criterion.

The Group 4 Project

This will continue to be an essential requirement of the all Group 4 courses. It is a very valuable exercise in practicing candidate-generated investigations. It is being used by some teachers for the assessment of criteria where the candidate should be assessed on their individual capacities. As the Group 4 Project is a collaborative effort this is not appropriate to use it for assessment in this way. In the revised programme the project will <u>only</u> be used for the assessment of Personal Skills and nothing else. The project will also be the opportunity for the candidates to show how internationalism operates in scientific enterprises.

Recommendations for the teaching of future candidates

- Consult the online curriculum centre (OCC) frequently for Teacher Support Materials (TSM). New guidelines and exemplars have been published. Guidelines for the programmes that started in September 2007 and are examined from May 2009 are already posted

- Do **not** use workbooks and work sheets with spaces to be filled in for internal assessment.

- Explain the criteria to your candidates at the beginning of the course and at intervals during the course.

- Use non-assessed practice exercises for training your candidates.

- Select investigations carefully for assessment so that they are not trivial.

- Provide situations that are open-ended and with enough scope for variation when assessing Planning (a) and (b) (these become Design in the new programme).

- Teach the candidates early on how to carry out error analysis on their data and train them in data processing techniques.

- Do not provide too much guidance. Use investigations where the candidates have to carry out tasks on their own or where their individual efforts can be assessed.

- Use the notation c (complete), p (partial) and n (not at all) on the work assessed for internal assessment and provide additional notes on the sampled work (not just for the benefit of moderator but also for your candidates too).

- Provide clear, precise information on the instructions given to the candidates.

- In schools where there are several teachers, practice internal moderation.

- Teachers must be vigilant to prevent collusion between candidates when they are assessing the criteria. Setting the planning phase as a test may be a way of avoiding collusion between candidates.

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Higher level paper one

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 8	9 - 17	18 - 24	25 - 27	28 - 31	32 - 35	36 - 39

General comments

Nearly 140 G2 forms were submitted, which helped the examining team to make appropriate decision about this paper during the grade award process. Two thirds thought that the paper was of a similar standard to that of last year and one quarter thought it was a little easier. The remainder thought that it was a little more difficult. However, more than 90% of teachers thought that the level of difficulty was appropriate. More than 80% thought that the syllabus coverage, clarity of wording and presentation were good and only one or two teachers thought that the paper was poor in any of these respects. There were many discriminating questions on this paper and a small number of questions that performed less well.

The strengths and weaknesses of the candidates in the treatment of individual questions

Some questions performed in a predictable way and no comments need to be made about them. The comments that follow relate to questions where candidate performance was very good or very poor or questions that aroused comment from teachers on G2 forms.

Question 1

Some teachers felt that answer C was acceptable, but it would include all the cells in an organ for example, which would be a combination of several tissues rather than a single tissue. Many candidates answered this question incorrectly, but the discrimination index shows that the stronger candidates mostly answered correctly.

Question 4

Some teachers disliked this question and it would have been better if the correct answer had been *as a component of some proteins.* It was possible to find the correct answer either by knowing that nucleic acids, lipids and carbohydrates lack iron or by knowing that hemoglobin is a protein and it contains iron.

Question 7

This question discriminated well and many candidates answered it correctly. Some teachers felt that glucose is not a product of anaerobic cell respiration but this did not affect the answer and if glycogen in muscle was the starting point, glucose would be an intermediate product.

Question 9

This question was answered correctly by nearly 90% of candidates, showing good knowledge of both gender determination and the cause of Down syndrome.

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Question 13

This was one of the least successful questions on the paper. Most candidates easily recognised the syllabus definition of a community and as a result the question did not discriminate well. The examining team felt in retrospect that two of the answers, B and C, were too close to the accepted answer. It is not the policy in IB Biology to test memorisation of specific wording but instead to test understanding. Concern was expressed that this question might have penalised those who were working in their second language but there was no evidence of this.

Question 14

There was a small typographical error in answer A, but it was clearly still the correct answer, not C.

Question 15

Candidates found this question very easy and it did not therefore discriminate well. A few candidates thought that increased genetic variation limited population growth but apart from that, almost all candidates answered correctly.

Question 16

This was a well-answered question, demonstrating good knowledge of binomial nomenclature.

Question 19

The examiners agreed with some teachers' comments that this diagram was les clear than it should have been but most candidates were still able to find the correct answer.

Question 20

This was the most problematical question on the paper because of the word *fasting*. There is cultural variation in the nature of fasting and in particular whether any water is drunk. This affected which answer was correct. With a very small percentage of candidates choosing the expected answer and an extremely poor discrimination index, the examining team had no hesitation in deleting this question.

Question 21

More than 95% of candidates answered this correctly, showing sound knowledge of the structure of the male reproductive system.

Question 22

A common misunderstanding revealed by this question is that progesterone secretion in the follicle is stimulated by FSH, but if this was the case, progesterone would be secreted in the first half of the menstrual cycle, which it is not.

Question 23

Some teachers felt that this question was testing trivial details, but ironically it proved to be the most discriminating question on the paper.

Question 24

The quality of the diagrams here was not as high as it could have been but it was still a discriminating and effective question. Translocation of the ribosome along the mRNA was not shown so C was not a correct answer.

Question 25

This was a very effective question with a high discrimination index. It is not an area that weaker candidates will ever find easy, but careful teaching of it will of course help.

Question 28

Some teachers felt that the graph could have shown the effect of carbon dioxide concentration or light intensity but the graph showed a drop in the rate of photosynthesis at supraoptimal levels, which is symptomatic of temperature.

Question 30

This was not well known by some candidates. The question was testing Assessment Statement 8.3.3

Question 31

Recombination is an area that has caused considerable confusion among teachers and candidates over the years and this question shows that there is still a problem, as fewer than half answered it correctly and some stronger candidates got it wrong. In the new programme recombination has been dealt with differently and this may reduce problems in future.

Question 33

This question had a poor discrimination index. Only answer C was accepted. A surprisingly high number of candidates chose D, which gave events in the reverse sequence. This topic may need to be taught more carefully in some schools, to make cause and effect clearer in early pregnancy.

Question 37

There was an error in the diagram, with lines in the centre of the sarcomere that did not correspond with any structures, but it did not affect the answer. The only common error was to confuse actin and myosin.

Higher level paper two

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 10	11 - 20	21 - 26	27 - 36	37 - 47	48 - 57	58 - 72

General comments

Nearly 110 G2 forms were submitted, which helped the examining team to make appropriate decisions about this paper during the grade award process. 77% thought that the paper was of a similar standard to that of last year and 13% thought it was a little easier. The remainder

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thought that it was more difficult; however, 95% of teachers thought that the level of difficulty was appropriate. Nearly 80% thought that the syllabus coverage and clarity of wording were good and 90% thought the same of the presentation. Only one or two teachers thought that the paper was poor in any of these respects.

The strengths and weaknesses of the candidates in the treatment of individual questions

Section A

Question 1

(a) (i) Many candidates scored well on this question. Marks over 50% were regularly seen. This shows that the mark scheme was easily accessible for the full range of candidates.

(ii) A significant proportion of candidates misread this question and gave the answer 9.00 rather than giving the core temperature.

(b) Both high and low scoring candidates were able to gain marks here, it was rare for candidates to score zero. In part c only the high scoring candidates gained the third mark point linked to the generation of more heat.

(c) It seemed that time of day was read literally by many candidates, so they gave the answer as 9.00. However the axes were clearly labelled and candidates should be reminded to read all data and questions very carefully.

(d) This was a discriminating question and required candidates to make the link with respiration, it was disappointing to see that so few candidates did make the link. Only a few were able to follow the reasoning through and therefore gain two marks. Vague answers e.g. rats consumed more oxygen because they were more active did not gain marks.

(e) (i) The data required careful consideration and the majority of candidates were able to state that the control rats consumed more oxygen, only a few considered the fasting data.

(ii) This question was interpreted in two ways by the candidates. The fasting rats' oxygen consumption did not rise significantly therefore answers relating to increased activity, shivering and the metabolising of glycogen were incorrect. Candidates possibly focused on Figure 1 as opposed to Figure 2. As this was a suggest question, sensible answers linked to the conservation of heat were accepted.

(f) A few candidates lacked precision when reading the graph and so lost marks.

(g) The majority of candidates gained only one of the two marks here. Most manipulated the data to support their conclusion but did not state reasons. This was another instance when the link to respiration was missed.

(h) The question required candidates to summarise the findings and this was the most challenging part of question 1. Nearly all stated that leptin increased core temperature but were vague when outlining the effects of nutrition or light. It was expected that candidates should bring together the findings on nutrition, light and hormones. Some candidates did make the link with respiration in this question.

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Question 2

(a) Candidates who knew this material scored highly but it was disappointing to see many candidates scoring zero. Teachers commented that the second label on the diagram was not clear but both receptor and binding site were on the mark scheme therefore candidates were not penalised in anyway.

(b) The ability to be precise when explaining processes was essential here. Candidates referred to vesicles being removed from the synaptic bulb rather than the neurotransmitter and in (b) referred simply to proteins rather than tropomyosin and troponin.

Question 3

(a) (i) Marks were lost because candidates did not know or did not write a full definition. Candidates knew that alleles are variations of a gene, however very few candidates stated that alleles exist at the same locus.

(ii) Candidates appreciated the implications of a base substitution and gave sickle cell anemia as an example. Some understanding of the effect on the codon, the amino acid or the protein was also expected.

(b) This was a discriminating question as candidates found it difficult to explain why the genes were probably linked, although many did gain one mark for stating that the genes were (probably) linked. The majority simply explained how a dihybrid cross results in a 9:3:3:1 ratio.

(c) There were some very surprising answers as to which statistical test could be used. A large proportion of candidates named test crosses and Punnett squares which demonstrates a lack of understanding of the phrase statistical test. Only the higher scoring candidates seemed to have read the question carefully and picked up on the need to outline the test in the answer.

Section B

The popularity of the questions was largely equal and the full range of marks were seen. Many candidates showed a very clear understanding of basic concepts but others had only general comments to make with little or no Biological content.

Question 4

(a) The quality of diagrams was disappointing and candidates lost marks because structures were either unrecognisable or not actually attached to the ovary or the receptacle. These should be straightforward marks and it is a pity that a significant number of candidates are not more proficient. Some candidates drew whole plants and others only carpels.

(b) G2 comments suggested that this question required more that the syllabus states but the mark scheme was tailored to the syllabus and there were lots of mark points available. The question requires candidates to be selective in their choice of material and to link that material to variation. To gain full marks candidates needed to plan their answers by looking at each stage of Meiosis and identifying how the process resulted in variation in the genetic make up of pollen. Candidates lost marks because they failed to identify the various stages. Crossing over was the commonest answer but often with extensive explanations that gained no credit.

(c) The majority of answers focused on the struggle for survival but answers lacked the structure necessary to explain natural selection. The discussion of how variety in populations came about was only seen occasionally.

Question 5

(a) This should have been a straightforward question and the vast majority scored highly, however a number of candidates failed to name the different methods of transfer e.g. diffusion and osmosis and marks were lost as a result.

(b) Few full answers to this part were seen. Answers often focused on transport through the vascular system ignoring transfer through the cortex. This had a negative impact on the scores achieved. All candidates were aware that water travelled through the xylem, a small number also suggested that water is transported through phloem.

(c) The quality of answers was often linked to the centre suggesting that some topics had not been covered in the necessary depth. High scoring candidates were able to produce concise detailed answers, often gaining maximum marks. This question provided an opportunity for weaker candidates to gain some marks by simply stating that more water is reabsorbed if blood water levels are low and vice versa. Some candidates answered this part in terms of water absorption in the large intestine.

Question 6

(a) This material appeared to be very familiar to candidates although the ability to explain tertiery structure was difficult for many.

(b) Putting the comparisons into a table demanded a high level of understanding and an ability to be selective when constructing the comparisons. As a result this was a discriminating question and only a small number gained all the marks available. Only a very small number of answers contained examples of competitive and non-competitive inhibition.

(c) This was a very clear question and many gained maximum marks. Explanations were often clear and comprehensive. Marks were lost when candidates failed to name the actual cell types involved e.g. helper T-cells and B-cells. Some answers were very detailed; this was pleasing as it demonstrated a thorough understanding of the material.

Question 7

(a) Some good answers seen, many used an annotated diagram and prose. It was encouraging to note the large number of candidates that correctly quoted the percentage of energy transferred or lost between trophic levels. The last mark point relating to the fact that not all components of an organism are eaten was only seen on a small number of scripts.

(b) Answers to this section were often lengthy and contained significant amounts of repetition, often resulting muddled answers. Candidates should aim to organise their thoughts before writing to ensure that answers are as clear and concise as possible. All mark points were seen and overall it was a high scoring question.

(c) Once again some lengthy answers; these were able to score highly on the content but the style was often poor, resulting in zero or one for Quality marks. In this question candidates were required to put ideas together to gain one mark, there were relatively few easy marks available.

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Recommendations and guidance for the teaching of future candidates

- Provide simple line diagrams of all diagrams specified and test students on them regularly. These should be seen as relatively easy marks with very clearly stated labels.

- For the extended sections worth 6 or more marks, candidates should produce a map or plan so that they can organise the material into a logical sequence before writing, to avoid repetition and muddled answers. It appears that many candidates simply regurgitate information and they need to be more selective. Candidates should always be encouraged to use specific terminology so that they are fully familiar and therefore less inclined to write in very vague and general terms.

- Definitions are stated clearly in the syllabus and, as with diagrams, candidates should be encouraged to focus on these.

- Data should be examined carefully and questions read carefully to increase the likelihood of addressing all parts of a question.

Higher level paper three

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 5	6 - 11	12 - 14	15 - 19	20 - 25	26 - 30	31 - 40

The areas of the programme and examination that appeared difficult for the candidates

Option D - Defining Humans as primates

Option E - Imprinting

Option F -Plant growth regulators

Option F- Transgenic techniques

Option G - Competitive exclusion principle

Option G- Naming an extinct animal

Option H -Drawing a labelled diagram of exocrine glands

The areas of the programme and examination in which candidates appeared well prepared

The candidates found difficulties in the interpretation of the data in options D, F and G. Better answers and interpretations in general were seen in data analysis questions in options E and H.

In the longer answers, in options E and H, some very good answers were seen. Option F proved to be the option that presented most difficulties for the candidates.

In general many candidates did better in the shorter data analysis questions. Often the longer answers were too general and demonstrated a lack of depth of knowledge.

Compare and discuss are the action verbs that presented most difficulties.

Use of correct biological terminology was too often lacking.

Too many candidates were using extra paper to answer their questions, which rarely leads to extra marks being awarded because answers tend to be too long with irrelevant material included.

Too many candidates were attempting more than two options and so were having too little time to answer any of the options fully enough.

Option D, E and G were most frequently answered. Very few candidates attempted option F- this in general was very poorly answered. E also poorly answered. Few did option H, but those that did often gave good answers.

The strengths and weaknesses of the candidates in the treatment of individual questions

Option D

Question 1

(a) Most candidates were able to correctly identify *Carettochelys*.

(b) Most candidates recognized that *Graptemys* diverged more recently than *Chelonia*. Many recognized that both share a common ancestor. Few candidates identified that *Chelonia* has three divergence points whereas *Graptemys* has five.

(c) Most candidates were able to identify *Graptemys* and *Trachemys*. Some suggested other closely related genera, *Emys* being the most often cited. Other lines of reasoning in order to discuss fully the data, that is, answers such as, lack of fossil evidence to show that other pairs could be more closely related, or reliability of molecular data /fossil dates could be questions, were not seen.

Question 2

(a) There were some good definitions of the term *species.* But many candidates failed to include the ideas that difficulties presented by species that appear different but are able to interbreed, or that appear to be identical but cannot do so successfully. Quite a number incorrectly used the example of a horse and a donkey.

Some candidates did recognize an older definition of species in terms of morphology and how this lead to difficulties in defining species. Some better candidates did refer to clines and organisms reproducing asexually as being examples of difficulties. Some candidates were able to give an accurate definition of species.

Occasionally some wrote that speciation was the classification of organisms into taxa, hence confusing classification with speciation.

(b) Although some candidates answered very well here, many candidates could not outline the process of speciation. Isolation was often stated (rarely was the term reproductive isolation used), but not the necessity of natural selection. Unless candidates had shown an understanding of isolation and natural selection it was not possible to gain the mark point that the resulting species cannot interbreed because the question demanded the process of speciation, not just the outcome.

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Question 3

    (a) The most common answers were opposable thumb and stereoscopic vision and upright posture. Few stated nails on some digits, or a small number of young per pregnancy.

    (b) Some of the better candidates did very well here. Many though did not discuss the evidence for the theory that modern humans are descended from African apes, evidence was stated- but without discussing how this evidence upholds the theory. There was though a tendency for answers to be repeated from D3 (a) here.

Option E

Question 1

    (a) Most candidates successfully stated that crayfish fight for shelter much longer than for live food. Some did use comparative statements to indicate that crayfish fight for shelter for up to 31 seconds, but only up to 6 second for live food. Few stated that the short 1-3 second flights are 90% of fights for live food but only 4 % for shelter. Quite a few extracted data but did not use it to compare the fighting times and the areas preferred. Few really answered the question clearly by comparing the percentage of time spent fighting in two areas.

    (b) (i) and (ii) The average lengths of fights in sheltered areas and areas rich in food were correct for most of the candidates. Many also stated the correct ratio.

    (c) Many did recognize that the crayfish prefer shelter as the fights for this were longer, thus gaining two marks. Very few gained a third mark here, but where a this mark was gained this was for stating that live food was least desired because the fights for this were shorter. It was rare that little difference between fight time for live and dead food was stated.

Question 2

    (a) It was rare for a candidate to define imprinting correctly. Few stated this as a learned behaviour, although the second half of the definition was usually stated- a behaviour that develops as a response to stimulus during a sensitive period (of development). Some used the terms response, stimulus, sensitive period. For a definition, this was poorly answered in general.

    (b) Candidates in general gained two mark points here although correct terminology was often lacking.

Question 3

    (a) Those candidates who had studied the eye did well. The least known structures were sclera, choroids and vitreous humour.

    (b) Good candidates gave some good detailed answers, however, correct terminology was sometimes lacking even with the better candidates. The most common answers were that parasympathetic and sympathetic are parts of the autonomic nervous system and are antagonistic systems. Many knew that the sympathetic NS prepares for threat but few stated that parasympathetic returned systems to the "norm", stating that the parasympathetic system was in use at times of rest which did not gain a mark. The correct interpretation of why more or less light enters the eye was rarely related to the iris, and more rarely still related to iris muscles. Neurotransmitters were

occasionally stated although some candidates incorrectly stated adrenaline instead of noradrenaline.

Option F

Question 1

   (a) (i) Most candidates were successful in calculating the average number of plants. Many could give an acceptable reason for why cotton yield was lower in 1992 for part (ii). Often drought or lack of minerals was stated.

   (b) The candidates found this question difficult. Few were comparing yield of cotton plants to the number of plants with most using one or the other to compare year by year.

   (c) Most candidates recognized that not plowing would be preferable to plowing.

Question 2

   (a) The candidates who did answer here stated that auxins result in plants bending towards the light but few could state any more details about how auxins work.

   (b) Few candidates could describe the commercial use of plant growth regulators.

Question 3

   (a) This was very poorly answered. Few candidates could state a valid example of the use of transgenic techniques. Candidates are unable to name examples and often confused transgenic techniques with cross breeding and the use of exogenous hormones to promote growth and milk yield.

   (b) This was also very poorly answered. Very few candidates could discuss any one ethical issue.

Option G

Question 1

   (a) Most candidates could average the mass of juvenile birds leaving their nest in 1989

   (b) Many candidates did state that in the years where mass is low, the number leaving the nest is low (or vice versa). Few gained a point for stating that this was a strong correlation.

   (c) Few really answered the question in discussing the implications of global climate changes. Most candidates gave general answers for example: in colder weather the mass of birds leaving the nest is greater. Few noted the trend towards El Nino.

   (d) Better candidates did notice that a more negative SOI, could lead to a decline in warblers.

Question 2

Better candidates who had studied this gave very good precise answers. Too many candidates were writing about competition between organisms in a general manner. Many also seemed to have confused evolution and natural selection with competitive exclusion.

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Question 3

(a) Few candidates named a recently extinct species. The common answers which earned marks were the Dodo bird and Carolina parakeet. Those who did not name a recently extinct species could still gain marks for stating good ecological and conservational arguments that do lead to extinction such as hunting or loss of habitat. Many incorrectly stated dinosaurs and reasons for their extinction. Many also stated arguments concerning global warming as reason for extinction; no marks were gained for this.

(b) Some good answers were seen here. The most common points gained were valuable commodities, aesthetic beauty, ecotourism, interdependence. Few gained seven marks here. Many candidates confused global warming and the importance of plants for photosynthesis to reduce carbon dioxide levels with arguments for biodiversity.

Option H

Question 1

(a) Most candidates gained at least one mark by stating that as coffee consumption increased C-peptide concentration decreased. The second most common mark point gained was for stating that most effect is seen when more than three cups of coffee are consumed. Few discussed points concerning either obese women or normal weight women.

(b) Most candidates earned a mark by comparing drinking more that 4 cups of caffeinated coffee a day to less C-peptide in those who drink no coffee. Some also added that the difference is greatest in obese women/ least in normal weight women.

(c) Many candidates recommended drinking four cups of coffee a day- although some forgot to state whether this should be caffeinated coffee or not, although it was assumed that caffeinated coffee was meant here. Some also mentioned that losing weight, if overweight, could also reduce C-peptide levels.

Question 2

(a) Those candidates that had learnt the definition of partial pressure defined this very well.

(b) Many candidates stated increased ventilation rate, increased red blood cells and increased lung capacity to outline how the body acclimatizes to high altitudes.

Question 3

(a) Some better candidates provided excellent fully labelled and correct diagrams but in general the diagrams were poor, or incorrect.

(b) Some candidates gave excellent answers here. The weaker candidates only gave general answers about negative feedback.

Recommendations and guidance for the teaching of future candidates

- Ensure that candidates know that they must only answer two options.

- More depth of knowledge is required to answer the longer answers.

- Correct terminology is a necessary requirement for Higher Level papers.

- Colloquial phraseology should be avoided in IB Biology examinations as it lacks the precision that the examiners are looking for in candidates' answers.

- Candidates should be taught the options and not be required to study them on their own.

- Candidates should be familiar with the action verbs and how to use them in answering questions through repeated use of them during the course.

- Candidates should be familiar with the definitions of biological terms as given in the programme guide.

- Answers need to be concise rather than excessively long and repetitive. Some schools seem to have recommended the use of extra paper at all costs- however, it was very rare to find marks to award on the extra material. Encourage candidates to use only the space given in the answer booklet.

- Encourage candidates to identify the **number of marks** awarded in each question and use it as a guide to incorporate the appropriate **number of points** to be written in a response.

- Candidates should be encouraged to practise drawings, including the labelling of them.

Standard level paper one

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 7	8 - 13	14 - 19	20 - 21	22 - 24	25 - 26	27 - 30

General comments

G2 forms gave a generally favourable response to this paper, with 96% reporting that it was appropriate in terms of level of difficulty, with the remainder considering it too difficult. Nearly three quarters considered it similar in difficulty to last year's paper but most of the remaining G2 forms suggested that it was easier. These comments fit in with the view last year from a significant number of teachers that the paper was too hard. More than 80% felt that this year's paper had good syllabus coverage, clarity of wording and presentation with the remaining forms rating the paper satisfactory in these respects.

The strengths and weaknesses of the candidates in the treatment of individual questions

Some questions performed in a predictable way and no comments need to be made about them. The comments that follow relate to questions where candidate performance was very good or very poor or questions that aroused comment from teachers on G2 forms.

Question 1

This question discriminated well at SL, with the stronger candidates identifying the definition of a tissue. It is a common question with HL Question 1 and further comments are made in the HL report.

Question 3

Some teachers felt that both B and C could be correct answers. The terminology for membrane proteins is specified in the programme guide. Protein 1 was not peripheral as it straddles the membrane so B was rejected as an answer.

Question 6

This is common with question 4 of the HL paper and comments are made on the HL report. Only about two thirds of SL candidates answered it correctly with about one fifth of candidates thinking that nucleic acids contain iron.

Question 8

This was a particularly well-answered question, with most candidates showing a good knowledge of the composition of a DNA nucleotide.

Question 9

This is common with question 7 of the HL paper and comments are made in the HL report. It was an effective question in the SL paper.

Question 11

Only slightly more than half of candidates answered this question correctly, which is surprisingly few. Weaker candidates mostly chose the answer that had T instead of U in the product of transcription, perhaps indicating confusion between RNA and DNA or transcription and replication.

Question 12

This was a well-answered question, with few candidates failing to identify the chromosomes of a girl with Down syndrome.

Question 15

This question discriminated more poorly than expected. Some of the stronger candidates seem to have chosen answer D. Perhaps the word gender was unknown to some.

Question 17

This was answered correctly by nine out of ten candidates, indicating good understanding of an admittedly straightforward example of inheritance.

Question 18

This was one of the least popular questions with teachers both on the SL paper and as question 13 on the HL paper. Comments are made in the HL report. It discriminated well between candidates at SL.

Question 20

Several teachers commented that this question did not have a correct answer and only a third of candidates got it right, though it discriminated well. D was the correct answer as it gave the range 95%. This is the percentage of the population that is expected to lie within two standard deviations of the mean, as indicated in the teachers note in the programme guide.

Question 24

Some teachers felt that the diagram was rather unclear and the examining team had sympathy with this view, but despite this most candidates answered it correctly and it was not a particularly strong discriminator. More comments are made in the HL report as it was common with HL question 19.

Question 25

This question showed good knowledge of the structure of the male reproductive system as it was answered correctly by nearly 95% of candidates.

Question 26

This was the second most poorly answered question on the paper, indicating widespread lack of knowledge of the muscle actions involved during inhalation. Fewer than half of candidates answered correctly.

Question 27

This proved to be the best discriminator on the paper, which was perhaps surprising as none of the answers fully described the composition of human blood and the only comment on a G2 form was that it was a poor question!

Question 29

This was the only question over which examiners had serious concerns. The role of body hair in helping to control body temperature is not in the SL programme. Also it is possible to argue that hair is or is not significantly involved as humans have reduced body hair and wear clothes. To make this question fair, both answers A and D were accepted.

Question 30

Most candidates realised that high salt intake leads to high slat concentration in urine. Most also realised that high protein intake would lead to high urea concentration in urine. The SL syllabus does not include urea production by deamination of excess amino acids but nonetheless the examining team felt that candidates could be expected to know that amino acids contain nitrogen and that urea is a nitrogenous waste product.

Standard level paper two

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 8	9 - 17	18 - 22	23 - 28	29 - 34	35 - 40	41 - 50

General comments

Only 45 G2 forms were received from teachers, of which most found the standard of SLP2 to be similar, perhaps a little easier, when compared to last year's paper. The level of difficulty was deemed appropriate. Clarity of Wording and Presentation of Paper were perceived to be good; Syllabus Coverage was seen as either Satisfactory or Good.

The areas of the programme and examination that appeared difficult for the candidates

There was no part of the examination that was universally difficult. There were a few schools where many candidates were both articulate and rich in knowledge throughout Sections A and B. In sharp contrast, there were other schools where many candidates performed poorly throughout Sections A and B. Consequently, overall marks for individual scripts ranged from almost nothing to almost perfect. Generally, it appeared that *only a few* candidates came well prepared. Many scripts reflected a reasonable level of knowledge. However, understanding was not expressed well enough for some. Candidates tended to perform better on Section A than Section B.

The following biological concepts covered by the examination proved consistently difficult for candidates:

- Relating the ratio of surface area to volume to limiting cell size.

- Relating significance of complementary base-pairing to DNA replication.

- Linking genetic variation in sexual reproduction with meiosis.

- Analyzing advantages and disadvantages

- Describing natural selection/evolution.

Many candidates wrote poorly developed answers to essay questions (Section B) where answers were incomplete or very brief shallow answers. In particular the logical flow of ideas was difficult for a large number of candidates. Overall a wide range of abilities was demonstrated. Although only a very few candidates answered all the questions correctly, all of the questions were answered correctly by some candidates. Many candidates demonstrated some knowledge of the areas covered by the questions, but very little understanding. Other candidates provided fully developed, but completely unrelated answers or answers based on wrong concepts.

The areas of the programme and examination in which candidates appeared well prepared

Some candidates showed deep understanding of the material, logical thinking and high capacity for expressing themselves clearly and correctly. This was especially evident in Section B.

Candidates were generally well prepared for data analysis questions with most candidates scoring most of the points on question 1. Many candidates responded well to the questions on hormones (question 3) and ecology (question 4c)

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The strengths and weaknesses of the candidates in the treatment of individual questions

Section A

Question 1

Parts a, b, c, d and e were generally well answered by most candidates with a few failing to show their working on part d.

(f) Some candidates struggled to structure their answers clearly and many did not link their ideas to an actual advantage or disadvantage. The majority of candidates who did poorly did not appreciate that they had to process the information and think up advantages and disadvantages. Often data was simply repeated.

Question 2

Many candidates did poorly on all sections of this question suggesting unfamiliarity with this core topic.

(a) Although candidates could recall the cell sizes, they gave the wrong units demonstrating that the syllabus expectation of relative sizes of cells had not been mastered.

(b) Many candidates seemed to understand what SA/V ratio meant but this question was still poorly answered. Candidates found it difficult to explain the ratio and then link it to cell size. They had a difficult time communicating their ideas with few candidates gaining full marks. Despite this being a difficult concept to explain, there were many good answers, making this question a good discriminator.

Question 3

(a) Surprisingly the definition of homeostasis was not well known with candidates describing homeostasis as equilibrium related to passive transport.

(b) (i) Candidates could answer this question with either insulin or glucagon, but needed to give the site as either the beta cells or alpha cells of the pancreas to gain full marks

(ii) Most candidates got some marks on this question but many failed to demonstrate an understanding of regulation or control (and so gained only partial marks).

(c) Some candidates wrote excellent answers to explain the role of estrogen in puberty. Some candidates misunderstood or misread the question and simply described the overall role of estrogen, earning only partial marks.

Question 4

(a) Many candidates performed well on this question. Those who missed it, failed to read "for energy storage in animals"

(b) In this question the emphasis was to be placed on the concept of energy conversion. Many candidates answered the question with photosynthesis as the focus, rather than energy conversion.

(i) Many candidates did not appear to understand the question and simply wrote

down the equation for photosynthesis.

(ii) Very few candidates understood the question so many did not relate chlorophyll to the process of energy conversion.

(c) The question on the pyramid of energy showed good differentiation between weaker and stronger candidates as most candidates gained some marks but only a few stronger candidates gained all of the available marks.

Section B

Question 5

(a) Listing the characteristics of alveoli was generally well done.

(b) Many candidates did not organise their thoughts to link structure and function resulting in vague, rambling answers.

(c) This question was criticized on G2 forms as being from the additional higher level or option C material. However, the markscheme reflects more than adequate points from the SL assessment statements only. Several candidates answered the question with information from the option and AHL, but only a mark or two was allowed for the additional detail as the context of the details must be present for a quality answer. Many candidates presented lots of HL information, whilst an understanding of the basics was not demonstrated.

Question 6

(a) Many candidates were able to draw and label the structure of DNA

(b) The idea of complementary base-pairing was clear in most candidates' work but its significance to replication was not evident. Many candidates lost marks through explaining protein synthesis at length and not really referring to DNA replication at all.

(c) Most candidates stated the correct cause of sickle cell anemia but the idea of natural selection was a problem to most of them. The concept of heterozygote advantage was missing with many candidates suggesting that having sickle cell anemia provided advantage against malaria. Many said the disease itself was helpful, completely missing the point that it killed most suffers until recently. The idea of natural selection and the way environmental conditions lead to natural selection was not understood by most candidates.

Question 7

(a) The sketch of a graph of population growth was well drawn. Points were lost when candidates failed to label the axes correctly, or drew the exponential portion of the graph in a linear fashion. Many candidates spent excessive time writing out a full description of the diagram, when only labels were expected. Valuable time was lost to this effort for no additional marks.

(b) This question had some of the worst answers. Many candidates failed to discuss meiosis and the sources of variation provided by the specific qualities of meiosis. Only a vague description of sexual reproduction was common for which only a point could be given. Many candidates wrote long, involved answers about patterns of heredity and dominant and recessive alleles, but left out the essentials of how these genes become segregated and recombined.

(c) Candidates tended to write at great length about evolution but usually failed to identify the environmental change and the specific population affected. Some candidates stated acceptable examples (finches, moths and bacteria), but failed to relate their discussion to environmental change. Some wrote extensive essays on human evolution, but did not relate it to the question. Understanding of natural selection and adaptation were poorly understood and expressed.

Recommendations and guidance for the teaching of future candidates

Instructional Strategies

- It is not enough for candidates to be given the information; they must be given opportunities to use it and to develop their understanding of the content of the syllabus.

- Familiarize candidates with the meaning of the command terms. Incorporate these wherever possible in local school testing and assignments. The command terms compare, explain and discuss were especially troublesome this year.

- Teach the entire syllabus in as much depth as possible. Where the syllabus asks for an unspecified example, teachers need to ensure that candidates learn a specific example.

- For open-ended topics in the syllabus, help candidates to learn specific named examples. For example, in a question such as 'Explain two examples of evolution of specific populations…' candidates should be able to cite one population, one environmental change that has affected the species, and one or more consequences of the change. If the topic is controversial and ripe for a discussion question, candidates must consider both sides of the issue so balanced arguments can be given.

- For topics where research is continually updated, teachers need to help candidates to distinguish between what has been done and what is still theoretical. In topics such as these, reliability of information sources is always important.

- Integrate data analysis exercises into day-to-day teaching. Make sure candidates can interpret various types of graphs such as scatter graphs, nomograms etc. Teach candidates to recognize overall patterns/trends in graphs and to look for relationships between the labelled axes.

- Give candidates more practice in drawing and annotation of diagrams and graphs

- Insist that candidates write units for numerical data. Practice in the use of simple calculations will help with data-based questions. It is expected that candidates can calculate amount of change (differences), means, modes, simple percentages and percentage change.

- Candidates need to understand definitions of italicized terms in the guide so that full definitions can be given.

- Using past exam papers (or similar standard questions), help candidates practise their writing skills for essay questions--especially where long answers to complex questions are required. Candidates should provide as much specific detail in accordance with the command term of the question, avoiding generalized examples. They must write answers with a sequence of thought that can be understood. Many

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candidates lose marks because they just write down one word that could have been relevant if written in a full sentence. Candidates should organize answers--possibly through an outline before actually writing. By defining key terms an additional mark could be earned. Incorporation of diagrams, where appropriate, enhances an answer.

- Above all, candidates need practice understanding the true meaning of a question. Apart from lack of information, many candidates struggled to either understand the questions or tailor their responses to the question.

- Candidates could be provided with practice papers and then evaluate how they respond with markschemes. They also should to be advised to read each question fully and carefully.

- Advise candidates to use the 5-minute reading time to thoroughly read the instructions on the front page of the exam and the stem of each question.

- Teach candidates how to complete the cover sheet.

- Candidates should avoid using extra sheets when writing their answers in Section A. Some candidates used extra sheets even when much room was left on the exam script. Other candidates wrote all their answers for Section A on continuation sheets. This practice was a disadvantage for candidates as their answers tended to be far longer than was appropriate, resulting in no extra marks. The practice also meant less time to devote to Section B, resulting in overall low marks.

- Candidates should note the number of marks shown in the brackets at end of each question and use that number as a guideline for how many distinct ideas to include in their response.

- Explain that in Section B only one question (in its entirety; a, b and c) should be answered as only one will receive marks. Some candidates did a part of each question and no question in its entirety. In this section candidates must choose their questions carefully. They should consider how many marks they can get for each part of a question before choosing the question.

- Remind candidates that examiners follow a positive marking policy. Avoid leaving blanks by not answering questions.

- Teachers should attend workshops periodically as expectations of the programme change.

Standard level paper three

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 5	6 - 10	11 - 16	17 - 20	21 - 24	25 - 28	29 - 36

General comments

35 G2 forms were submitted. Of these, 84% thought that the paper was of a similar standard to that of last year and 8% thought it was a little easier. The remainder thought that it was more difficult. However, 97% of teachers thought that the level of difficulty was appropriate. 71% thought that the syllabus coverage was good and this rose to 82% for clarity of wording

and 85% thought this of the presentation. Only one or two teachers thought that the paper was poor for syllabus coverage, none for the other aspects.

The accessibility of different Options seemed to be very close, with no obvious differences in the difficulty. Options A and D appeared to be the most popular and Options F and G the least popular, in terms of the number of schools that had prepared candidates for them. The standard of performance showed a wide spread, with few very low and few very high marks being awarded. It was however a little disappointing to see some candidates who obviously had had a poor experience, benefiting little from the course and producing very low marks.

It was pleasing to note that few candidates attempted more than the required two Options. It was surprising to note that many candidates continued their answers on separate sheets, often including many pages. Candidates should realise that the space allocated for an answer is a good guide to the length of an answer, and remember that quality rather than quantity is important. A few candidates wrote all their answers on separate sheets rather than using the script.   Application of skills seemed to be as much a problem as knowledge and understanding with marks not being awarded for a wide variety of reasons.

The areas of the programme and examination that appeared difficult for the candidates

Many candidates had difficulty in understanding and comparing data from graphs and charts. They tended to simply describe patterns or repeat data without any analysis or processing. Option E required candidates to produce a labelled diagram of the brain. The standard of drawing was extremely variable. It was difficult to tell whether this was due to a lack of knowledge, a lack of skill or both. Labelling was done rather carelessly so it was difficult to judge to which structure the label referred. A diagram was included in the mark scheme to show the minimum standard expected. Candidates continue to struggle with calculating a percentage increase .This was especially noticeable in Option A1 (b) with very few candidates correctly calculating the percentage increase.

The areas of the programme and examination in which candidates appeared well prepared

It was difficult to pick out any general strengths and weaknesses in biological knowledge. Many answers tended to be "centre specific", i.e. candidates from one centre producing good answers, yet candidates from another centre producing very poor answers to the same question. This emphasises the need for all topics on the options to be taught carefully.

The strengths and weaknesses of the candidates in the treatment of individual questions

Option A

Question 1

   (a) Most candidates correctly identified the percentage of very obese women.

   (b) A correct calculation of percentage increase was rare, most candidates simply subtracted the two numbers.

   (c) Most candidates correctly described the relationship between birth defects and BMI classification.

(d) This question showed good differentiation. Some candidates wrote clear and correct explanations, others wrote vague rambling statements without answering the question.

Question 2

(a) Writing a definition of a nutrient caused problems. Candidates clearly had to think up an answer instead of remembering a definition.

(b) It was surprising to note that many candidates wrote down named elements instead of named vitamins. On previous examination papers, candidates have scored well on questions about vitamins.

(c) Many candidates clearly did not know how to answer this question on saturated and unsaturated fats. It was common to read answers containing just one piece of information despite 3 marks being available.

Question 3

(a) There were many vague attempts (as well as some strange answers) to distinguish between vegan and vegetarian diets.

(b) The uses of cholesterol (membranes and steroid hormones) were not well known.

(c) Most candidates understood the reasons for malnutrition in populations and wrote detailed answers.

Option B

Question 1

(a) Most candidates correctly identified the required fitness programme.

(b) The calculation of percentage increase again caused a problem for the majority of candidates.

(c) Despite the complex nature of the question, most candidates clearly understood the data.

(d) A wide spread of answers to suggest treatment for patients was received, unfortunately some did not refer to the data.

Question 2

(a) The subdivisions of the skeleton (axial and appendicular) were not well known.

(b) Some candidates misread the question and simply described antagonistic muscles.

(c) This question on muscle changes showed good differentiation, some candidates writing good answers, other candidates showed a complete lack of knowledge.

Question 3

(a) The product of anaerobic respiration was well known.

(b) Few candidates understood the role of myoglobin in skeletal muscle.

(c) Few candidates were able to fully explain the roles of adrenaline in muscles.

Option C

Question 1

(a) Identifying the mean value from the graph caused few problems although some candidates did not include the required units.

(b) In calculating the percentage difference, some candidates chose different routes i.e. calculating the difference from the control group or from the mitochondrial myopathy group. Two answers were therefore accepted. As with other percentage calculations in other Options most candidates had problems attempting the calculation.

(c) Most candidates failed to offer more than one fact in their answer relating to a discussion the group tiring more easily.

Question 2

(a) Most candidates were able to name fibrous and globular proteins but many failed to give correct functions.

(b) Most candidates were able to name the correct axes but were not able to annotate the graph.

(c) Many candidates wrote good explanations of end-product inhibition.

Question 3

(a) Most candidates correctly identified the two sets of reactions in photosynthesis. Answers such as "light and dark reactions" were not given credit.

(b) Candidates' explanations of how a limiting factor affects photosynthesis were very confused and lacking in depth.

(c) This question on chemiosmosis produced good differentiation, allowing candidates with a good understanding of the process to score maximum marks.

Option D

Question 1

(a) & (b) Most candidates had no problems interpreting the data.

(c) Although many candidates realised that the two species had a predominance of haplotype B, they failed to score more than one mark by not offering a full answer.

Question 2

(a) Few candidates correctly identified the two substances thought to be responsible for polymerisation reactions.

(b) The conditions on pre-biotic Earth were well described.

(c) Some candidates wrote very detailed answers to explain the endosymbiotic theory, others confused it with the Panspermia theory.

Question 3

(a) The formation of fossils was well understood.

(b) Clearly many candidates had not thought about this type of question and offered vague explanations for the incomplete fossil record.

(c) This question on changes in human evolution resulted in many long winded answers covering many extra pages. A wide variety of answers was accepted.

Option E

Question 1

(a) Many candidates had problems in identifying the correct part of the brain.

(b) As in other Options, candidates had problems in working out a percentage difference.

(c) Candidates had a problem in understanding the logic behind the link between aggression and the amounts of serotonin. Those candidates who understood the link tended to write down a short explanation gaining only one mark.

Question 2

(a) Unfortunately many candidates wrote down vague examples such as "birds" or "butterflies" or "fish", and were not given credit.

(b) It was obvious from the candidates' answers that few had seen this diagram of rods and cones before the examination.

(c) A wide variety of answers were accepted as differences between rod and cone cells. Many candidates showed poor examination technique by not giving full answers i.e. writing down that rods are active in low light but not writing down what happens with cones.

Question 3

(a) Innate behaviour was well understood.

(b) As in past examinations, the quality of drawing was extremely poor. This was matched by the candidates' lack of knowledge of brain structure. Some candidates didn't know whether to draw it from the side or as a dorsal view and ended up with very confusing diagrams.

(c) This question exposed candidates' lack of examination technique. Candidates wrote long explanations of the pupil reflex but usually missed out what happened to the pupil, what type of reflex it was and why the link with the brain was important.

Option F

Question 1

(a) Most candidates were able to identify the correct time from the graph.

(b) Many candidates could not clearly compare the two graphs resulting in many vague and rambling answers.

(c) Candidates failed to realise that the question asked them to discuss storage in the two conditions. Most wrote down one comparison and scored only one mark.

Question 2

(a) Some candidates failed to realise that named examples of plants were required. Answers such as "trees", "shrubs", "garden plants" and "grasses " were not accepted.

(b) Many candidates seemed uncertain how to answer this question on the use of greenhouses. Candidates were expected to identify a condition which could be controlled in a greenhouse and then state the advantage of control.

(c) Some candidates wrote a very good appreciation of biological control, others had a very limited knowledge.

Question 3

(a) Most candidates realised that cutting off the tip was required.

(b) Good descriptions of plant growth regulators were rare. There was much confusion as to the use of plant hormones.

(c) A clear answer as to how veterinary techniques have improved the fecundity of animals was rare. As some candidates pointed out, they did not know what fecundity meant.

Option G

Question 1

(a) Most candidates correctly identified the lowest number, although a common mistake was to name the month.

(b) (i) Many candidates struggled to identify the correct months from the charts; using a ruler to vertically line up the data would have helped.

(ii) This question only required the difference (rather than a percentage difference) and it caused few problems.

(c) Since this question required clear thinking and other answers could be argued as being correct, a range of answers were accepted.

Question 2

(a) Many candidates failed to define gross production.

(b) Surprisingly, many candidates struggled to express their ideas on competition, parasitism, mutualism and herbivory clearly enough.

(c) Candidates were not expected to distinguish between primary and secondary succession, but rather to describe their combined effects i.e. development of soil with resultant changes in water retention etc.

Question 3

(a) Very few candidates were able to name a recently extinct plant.

(b) An explanation of the Simpson diversity index caused few problems.

(c) Many candidates wrote good descriptions of measures to conserve fish stocks, some answers being very long winded covering one or two extra pages.

Recommendations and guidance for the teaching of future candidates

- Candidates should be persuaded to tailor their answers to the marks available, i.e. a three mark question demands a detailed answer.

- Candidates should also be persuaded that the quality of answer not the quantity is important. Many candidates rambled on for many pages of extra sheets without credit.

- Analysis of data is an acquired skill and should be practised using past papers, simply repeating information is not analysing it.

- Good examples of drawings should be shown to candidates so they understand the expected standard.

- When a question asks for a named example it means a specific organism is required.

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